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(54) **Switch system for use with motor vehicle transmissions**

Schalteranordnung zur Verwendung mit Kraftfahrzeuggetrieben

Système d'interrupteur pour utilisation dans des transmissions de véhicules

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(56) References cited:
**EP-A- 0 551 000**
**US-A- 1 561 426**
**US-A- 4 125 929**

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## Description

### Field of the Invention

This invention relates generally to vehicular transmissions and more particularly to electrical switches for providing an electrical signal responsive to the position of the detent lever of the vehicle.

### Background of the Invention

It is conventional to mount a rotary switch on the transmission housing externally thereof to receive mechanical gear selection inputs from the operator of a vehicle through various linkages and output gear selections to a decoder module and the transmission electronic control unit via electronic signals. The switch includes a quadrant with a selected number of electrical switch segments disposed thereon with each segment providing an output to the decoder module. The manual valve controlling hydraulic operation of the transmission is mechanically coupled to a plate having indexing detents, called a detent lever, mounted on a shaft and pivotably movable therewith. The shaft extends through the transmission housing wall and a switch bar is fixedly attached to the shaft externally of the transmission housing so that when a vehicle operator selects a gear the switch bar within the rotary switch moves across the quadrant to a predetermined position to engage one or more of the electrical contact segments. In certain systems the electronic control monitors the gear position along with other inputs relative to such things as throttle position, output shaft speed, engine speed, engine load and so on.

In European Patent Application No. 0,551,000 a switch system is disclosed which is mounted within the transmission housing in order to avoid placing the switches in a hostile environment subject to water splash and the like as well as to avoid tolerance stack-up problems associated with linkages employed when mounting the switches externally of the transmission housing. In that application a switch housing is shown mounted on the manual lever shaft. The housing is coupled to the roller attached to the detent spring biasing the roller into engagement with the outer edge of the detent lever to maintain the housing stationary relative to the transmission housing. A switch arm fixedly mounted to the manual lever shaft mounts a plurality of first electrical contacts and extends into the switch housing. The switch arm, movable with the detent lever, moves into and out of engagement with respective second electrical contacts mounted on the switch housing. Annular seals are disposed between a hub of the switch arm and the switch housing to prevent ingress of metal particles and debris into the switch housing.

Switch systems made in accordance with EP-A-0,551,000 are very effective in obviating the prior art hostile environment and stack-up problems; however, in certain vehicles the space available to place a switch system within the transmission housing, especially in the direction taken along the longitudinal axis of the manual lever shaft, i.e., in a vertical direction, is so limited that there is insufficient space for conventional seal mechanisms needed to prevent ingress of metal particles and other debris into the switch housing.

It is therefore an object of the invention to provide an electric switching assembly responsive to gear selection which is free of the limitations of the prior art mentioned above and which can be fitted within available space of existing vehicular transmission housings. Another object of the invention is the provision of a switch assembly having a rotary member with an improved mechanism which allows passage of fluid but prevents ingress of debris and which occupies minimal space, particularly in the vicinity of the manual lever shaft, yet which is reliable and has a long useful life.

Other objects, advantages and details of the switch system of this invention and seal mechanism therefore, appear in the following detailed description of preferred embodiments of the invention.

### Brief Summary of the Invention

According to the present invention there is provided a switch system for use with motor vehicle transmission apparatus having a pivotably mounted manual shaft mounted in a bore through a wall of a transmission housing and having a longitudinal axis and a detent lever with a plurality of detents on an outer edge surface thereof, each detent corresponding to a specific transmission gear selection, a roller movable towards and away from the manual shaft and biased into engagement with the outer edge surface of the detent lever, the detent lever being mounted on the shaft so that the angular orientation of the detent lever is fixed relative to that of the shaft, the switch system comprising a switch housing mounted adjacent to the detent lever, the switch housing having two opposite ends, one end coupled to the roller to maintain the said one end of the housing in a fixed position relative to the transmission housing, the other end of the switch housing being pivotably mounted on the manual shaft, the switch housing having a base, a switch arm disposed within the housing and fixedly mounted on the manual shaft so that the angular orientation of the switch arm relative to the manual shaft remains constant, at least a portion of the switch arm disposed in the switch housing being generally parallel to and spaced from the base of the switch housing, switch means mounted within the switch housing including at least one first electrical contact mounted on one of the switch arm and the base and at least one spring biased second electrical contact mounted on the other of the switch arm and the base, one of the first and second electrical contacts being adapted to slide between respective contacts engaged and contacts disengaged positions with the other electrical contact as the manual shaft and switch arm are

pivoted, and means to prevent ingress of debris into the switch housing, characterised in that the switch arm and the switch housing have at least one pair of facing parallel annular surface portions extending around the manual shaft, each annular surface portion lying in a plane perpendicular to the longitudinal axis of the manual shaft and that the means to prevent ingress of debris comprises an annular sealing element located between the pairs of facing parallel annular surface portions and formed of resilient material and having outer and inner peripheral edges lying on one of said annular surface portions of the pair with a curved surface portion defined by rotation around the shaft axis of a convex arc extending from a point on the inner edge to a point on the outer edge, the curved surface portion having a selected value of crown height between the plane of said one annular surface portion and that portion of the curved surface portion furthest from that plane, the parallel annular surface portions being spaced from one another by a distance less than the selected value of crown height of the sealing elements, so that in use the sealing element is compressed between the pair of facing parallel annular surface portions.

In one embodiment of the switch system the switch arm and the switch housing have a second pair of facing parallel annular surface portions extending around the manual shaft and a second annular sealing element located between the second pair of facing parallel annular surface portions and formed of resilient material and having outer and inner peripheral edges lying on one of the parallel annular surface portions of the second pair, with a curved surface portion defined by rotation around the shaft axis of a convex arc extending from a point on the inner edge to a point on the outer edge, the curved surface portion having a selected crown height between the plane of the one of the parallel annular surface portions and that portion of the curved surface furthest removed from that plane in which the edges of the second sealing element lie, the second pair of annular surface portions being spaced from one another by a distance less than the selected crown height.

The switch housing and switch arm may be made of synthetic resin and the or each annular sealing element may be made of stainless steel.

## Brief Description of the Drawings

Fig. 1 is a cross sectional view of a switch housing as shown in EP-A-0,551,000.

Fig. 2 is a bottom plan view of a movable switch arm used in the Fig. 1 switch housing;

Fig. 3 is a cross sectional view, similar to Fig. 1, of a switch housing system made in accordance with a first embodiment of the invention;

Fig. 3a is a perspective view partly broken away of a seal element used in the Fig. 3 embodiment;

Fig. 4 is a fragmentary, cross sectional view of the seal arrangement of a second embodiment of the invention;

## Description of the Preferred Embodiments

Referring to the drawings, numeral 10 represents a switch system as disclosed in EP-A-0,551,000, referenced above. Switch system 10 comprises a switch housing having a base plate 12 provided at a free end thereof with a bifurcation forming a slot 14 which receives a detent roller 16 therein. A plurality of arcuately extending stationary contacts 18a, 18b, 18c and 18d are disposed on a circuit board 20.

An elongated switch arm 22 extends from a hub portion 24 along the top surface of base plate 12 generally in parallel relation thereto. A plurality of second electrical contacts 28a, 28b, 28c and 28d, are mounted on the lower surface of arm 22, one for each of the stationary contacts and being aligned therewith. In order to limit movement of switch arm 22 to that of manual shaft 30, hub portion 24 is fixed to the shaft as by forming a pair of parallel flat surfaces 24a which mate with a corresponding pair of parallel flat surfaces 30a formed on manual shaft 30 so that switch arm 22 is keyed to shaft 30 fixing its angular orientation to that of the shaft and movable therewith.

A top switch housing cover 32 is received over and fixed to base plate 12. Base plate 12 and housing cover 32 are each provided with an annular seal seat 34, 36 respectively in a bore which receives hub 24 which in turn is received on manual shaft 30. Lip seal 38 is disposed in seat 34 and lip seal 40 is disposed in seat 36 to seal the switch housing from the ingress of metal particles and debris into the switch contact area.

Electrical contact members 28a - 28d (see Fig. 2), are configured as elongated spring fingers biased downwardly so that they will engage base plate 12 when assembled in the switch housing. As manual shaft 30 is turned, contact fingers 28a - 28d will wipe along the top surface of circuit board 20 on base plate 12 and will engage respective stationary contact traces 18a - 18d at selected angular positions of shaft 30.

The switch system of Figs. 1 and 2 provides a sliding contact system which obviates prior art problems in which electrical contacts are subject to electrical shorting by conductive particles and slivers generated during normal operation of an automatic transmission. The system also provides an excellent reference to the mechanical system, i.e., the manual shaft 30 and detent spring (not shown) coupled to roller 16 which biases the roller into engagement with the outer peripheral edge of detent lever 42.

However, in certain vehicles the clearance between detent plate 42 and the transmission housing is insufficient to provide space required for seal mechanisms

such as that shown in Fig. 1 comprising seal seats 34, 36 and lip seals 38, 40.

A switch system made in accordance with the invention, shown if Fig. 3, utilizes seal apparatus which occupies virtually no vertical space. As seen in the Figure, switch arm 22' formed of any suitable material, such as synthetic resin, is similar to switch arm 22 of Fig. 1; however, hub 24' has a shorter dimension taken in the direction of the longitudinal axis of manual shaft 30, occupying no more space in the vertical direction, as seen in Fig. 3 than the switch portion of housing 44. A first annular seat 46 is formed in base plate 12', also formed of any suitable material such as synthetic resin, adjacent bore 48 and a second aligned seat 50 is formed in housing cover 32' adjacent bore 52. First and second annular seats 46, 50 respectively, are surface portions lying in respective planes which extend perpendicular to the longitudinal axis of manual shaft 30. A first annular seal element 54 is disposed on seat 46 and a second, similar annular seal element 56, is disposed on seat 50. Seal elements 54, 56 are formed of material having good spring characteristics such as stainless steel and are preformed having a smooth curved surface taken in a radial direction, as can be seen in Fig. 3a.

The curved surface portions have a selected crown height, that is, a height "c" shown in Fig. 3(a) between a plane in which the outer and inner peripheral edges of each element lies and that portion of the curved surface portion furthest removed from that plane. Annular elements 54, 56 are disposed on respective annular seats 46, 50 between switch arm 22' and base plate 12' and top housing cover 32' respectively at a distance less than crown height "c" so that the annular sealing elements will conform to the available space and effectively prevent passage of debris.

By way of example, a sealing element formed of material approximately .076mm (3 mils) thick having a suitable curved surface would have a crown height of approximately .038mm (1.5 mils) in the at rest configuration, that is, before being subjected to a load which would tend to flatten the element. The curved surfaces shown in Figs. 3 and 3a are somewhat exaggerated for purposes of illustration. Once the seal elements are placed on their seats and housing cover 32' is attached to base plate 12' by any suitable manner, seal elements 54, 56 will be loaded and will essentially conform to the surface of the seat and aligned portions of the switch arm 22'. However, the shape of the seal element will conform to clearances caused by any rocking or tilting movement of switch arm 22' and therefore will prevent particles and debris in general from passing by the seal elements into the switching area. At the same time fluid can pass by the seal and serves to lubricate the sliding surfaces between the crown portion of the seal elements and switch arm 22'.

Although the crown portion of the seal elements 54 and 56 are shown in engagement with switch arm 22', it will be appreciated that the crown side could be reversed, if desired, so that the crown would be received on a respective seat 46, 50.

With reference to Fig. 4, a modified embodiment uses a single annular sealing element 56 on one side of wall 25 of switch arm 22" in cooperation with surface portions 27, 29 formed on the opposite side of wall 25 and base plate 12" respectively. Surface portions 27, 29 are formed with matching curved surface portions extending in a radial direction so that close physical engagement will be maintained between the switch arm 22" and the base plate even with a slight skewed motion while resilient sealing element 56 will conform to the space provided by such motion thereby effectively preventing the passage of debris.

It should be understood that preferred embodiments have been described by way of illustrating the invention but that this invention includes various modifications and equivalents to the disclosed embodiments. It is intended that the invention include all modifications and equivalents of the disclosed embodiments falling within the scope of the appended claims.

## Claims

1. A switch system for use with motor vehicle transmission apparatus having a pivotably mounted manual shaft mounted in a bore through a wall of a transmission housing and having a longitudinal axis and a detent lever with a plurality of detents on an outer edge surface thereof, each detent corresponding to a specific transmission gear selection, a roller movable towards and away from the manual shaft and biased into engagement with the outer edge surface of the detent lever, the detent lever being mounted on the shaft so that the angular orientation of the detent lever is fixed relative to that of the shaft, the switch system comprising a switch housing mounted adjacent to the detent lever, the switch housing having two opposite ends, one end coupled to the roller to maintain the said one end of the housing in a fixed position relative to the transmission housing, the other end of the switch housing being pivotably mounted on the manual shaft, the switch housing having a base, a switch arm disposed within the housing and fixedly mounted on the manual shaft so that the angular orientation of the switch arm relative to the manual shaft remains constant, at least a portion of the switch arm disposed in the switch housing being generally parallel to and spaced from the base of the switch housing, switch means mounted within the switch housing including at least one first electrical contact mounted on one of the switch arm and the base and at least one spring biased second electrical contact mounted on the other of the switch arm and the base, one of the first and second electrical contacts being adapted to slide between respective contacts en-

gaged and contacts disengaged positions with the other electrical contact as the manual shaft and switch arm are pivoted, and means to prevent ingress of debris into the switch housing, characterised in that the switch arm and the switch housing have at least one pair of facing parallel annular surface portions extending around the manual shaft, each annular surface portion lying in a plane perpendicular to the longitudinal axis of the manual shaft and that the means to prevent ingress of debris comprises an annular sealing element located between the pairs of facing parallel annular surface portions and formed of resilient material and having outer and inner peripheral edges lying on one of said annular surface portions of the pair with a curved surface portion defined by rotation around the shaft axis of a convex arc extending from a point on the inner edge to a point on the outer edge, the curved surface portion having a selected value of crown height between the plane of said one annular surface portion and that portion of the curved surface portion furthest from that plane, the parallel annular surface portions being spaced from one another by a distance less than the selected value of crown height of the sealing elements, so that in use the sealing element is compressed between the pair of facing parallel annular surface portions.

**2.** A switch system according to claim 1 in which the switch housing and the switch arm are formed of synthetic resin and the annular sealing element is formed of stainless steel.

**3.** A switch system according to claim 1 or claim 2 in which the switch arm and the switch housing have second aligned annular surface portions extending around the manual shaft having matching curved surfaces extending in a radial direction.

**4.** A switch system according to claim 1 or claim 2 in which the switch arm and the switch housing have a second pair of facing parallel annular surface portions extending around the manual shaft and a second annular sealing element located between the second pair of facing parallel annular surface portions and formed of resilient material and having outer and inner peripheral edges lying on one of the parallel annular surface portions of the second pair, with a curved surface portion defined by rotation around the shaft axis of a convex arc extending from a point on the inner edge to a point on the outer edge, the curved surface portion having a selected crown height between the plane of the one of the parallel annular surface portions and that portion of the curved surface furthest removed from that plane in which the edges of the second sealing element lie, the second pair of annular surface portions being spaced from one another by a distance less than the selected crown height.

**Patentansprüche**

**1.** Schalteranordnung zur Verwendung mit einem Kraftfahrzeuggetriebe mit einer schwenkbar angebrachten Handwelle, die in einer Bohrung durch eine Wand eines Getriebegehäuses angebracht ist und eine Längsachse sowie einen Arretierungshebel mit mehreren Rasten an einer äußeren Randfläche aufweist, wobei jede Raste einer speziellen Getriebegangwahl entspricht, einer zu der Handwelle hin und von dieser weg beweglichen Rolle, die mit der äußeren Randfläche des Arretierungshebels in Eingriff gehalten ist, wobei der Arretierungshebel so auf der Welle befestigt ist, daß die Winkellage des Arretierungshebels bezüglich der Welle fest ist, wobei die Schalteranordnung enthält: ein angrenzend an den Arretierungshebel angebrachtes Schaltergehäuse, wobei das Schaltergehäuse zwei gegenüberliegende Enden aufweist, von denen das eine Ende mit der Rolle verbunden ist, um dieses eine Ende des Gehäuses in einer festen Position relativ zu dem Getriebegehäuse zu halten, während das andere Ende des Schaltergehäuses drehbar an der Handwelle angebracht ist, wobei das Schaltergehäuse einen Sockel aufweist, einen Schalterarm, der innerhalb des Gehäuses angeordnet und starr an der Handwelle befestigt ist, so daß die Winkellage des Schalterarms relativ zur Handwelle konstant bleibt, wobei wenigstens ein Abschnitt des Schalterarms, der in dem Schaltergehäuse angeordnet ist, allgemein parallel zu und im Abstand von dem Sockel des Schaltergehäuses verläuft, innerhalb des Schaltergehäuses angebrachte Schaltermittel mit wenigstens einem ersten elektrischen Kontakt, der auf dem Schalterarm oder dem Sockel angebracht ist, sowie wenigstens einem durch eine Feder vorbelasteten zweiten elektrischen Kontakt, der am anderen der beiden Elemente Schalterarm und Sockel angebracht ist, wobei der erste oder der zweite elektrische Kontakt zwischen einer Ineingriffsposition und einer Außeneingriffsposition mit dem jeweils anderen Kontakt verschiebbar ist, wenn die Handwelle und der Schalterarm gedreht werden, und Mittel zum Verhindern des Eindringens von Schmutz in das Schaltergehäuse, dadurch gekennzeichnet, daß der Schalterarm und das Schaltergehäuse wenigstens ein Paar zueinander gerichteter paralleler Ringflächenabschnitte aufweisen, die sich um die Handwelle erstrecken, wobei jeder Ringflächenabschnitt in einer senkrecht zur Längsachse der Handwelle verlaufenden Ebene liegt, und daß die Mittel zum Verhindern des Eindringens von Schmutz aus einem ringförmigen Dichtungselement bestehen, das zwischen den Paaren zueinander gerichteter paral-

leler Ringflächenabschnitten angeordnet ist und aus elastischem Material besteht und äußere und innere Umfangsränder aufweist, die auf einer der zwei Ringflächenabschnitte mit einem gekrümmten Flächenabschnitt aufliegen, der durch Drehen eines konvexen Bogens um die Wellenachse definiert ist, der sich von einem Punkt auf dem Innenrand zu einem Punkt auf dem Außenrand erstreckt, wobei der gekrümmte Flächenabschnitt einen ausgewählten Scheitelhöhenwert zwischen der Ebene des einen Ringflächenabschnitts und dem am weitesten von der Ebene entfernt liegenden Abschnitt des gekrümmten Flächenabschnitts hat, wobei die parallelen Ringflächenabschnitte in einem Abstand voneinander liegen, der kleiner als der ausgewählte Scheitelhöhenwert des Dichtungselements ist, so daß das Dichtungselement im Gebrauch zwischen dem Paar zueinander gerichteter paralleler Ringflächenabschnitten zusammengedrückt wird.

**2.** Schalteranordnung nach Anspruch 1, bei welcher das Schaltergehäuse und der Schalterarm aus Kunstharz und das ringförmige Dichtungselement aus Edelstahl gebildet sind.

**3.** Schalteranordnung nach Anspruch 1 oder Anspruch 2, bei welcher der Schalterarm und das Schaltergehäuse zweite in einer Linie verlaufende Ringflächenabschnitte aufweisen, die sich um die Handwelle erstrecken und zueinander passende gekrümmte Flächen aufweisen, die sich in radialer Richtung erstrecken.

**4.** Schalteranordnung nach Anspruch 1 oder Anspruch 2, bei welcher der Schalterarm und das Schaltergehäuse ein zweites Paar zueinander gerichteter paralleler Ringflächenabschnitte aufweisen, die sich um die Handwelle erstrecken, wobei ein zweites ringförmiges Dichtungselement zwischen dem zweiten Paar zueinander gerichteter paralleler Ringflächenabschnitte angeordnet ist und aus elastischem Material gebildet ist sowie äußere und innere Umfangsränder aufweist, die auf einer der parallelen Ringflächenabschnitte des zweiten Paares liegen, wobei ein gekrümmter Flächenabschnitt, der durch Drehen eines konvexen Bogens um die Wellenachse definiert ist, der sich von einem Punkt an dem inneren Rand zu einem Punkt am Außenrand erstreckt, wobei der gekrümmte Flächenabschnitt eine ausgewählte Scheitelhöhe zwischen der Ebene eines der parallelen Ringflächenabschnitte und dem Abschnitt der gekrümmten Fläche hat, in der die Ränder des zweiten Dichtungselements liegen, wobei das zweite Paar der ringförmigen Flächenabschnitte in einem Abstand voneinander liegen, der kleiner als die gewählte Scheitelhöhe ist.

**Revendications**

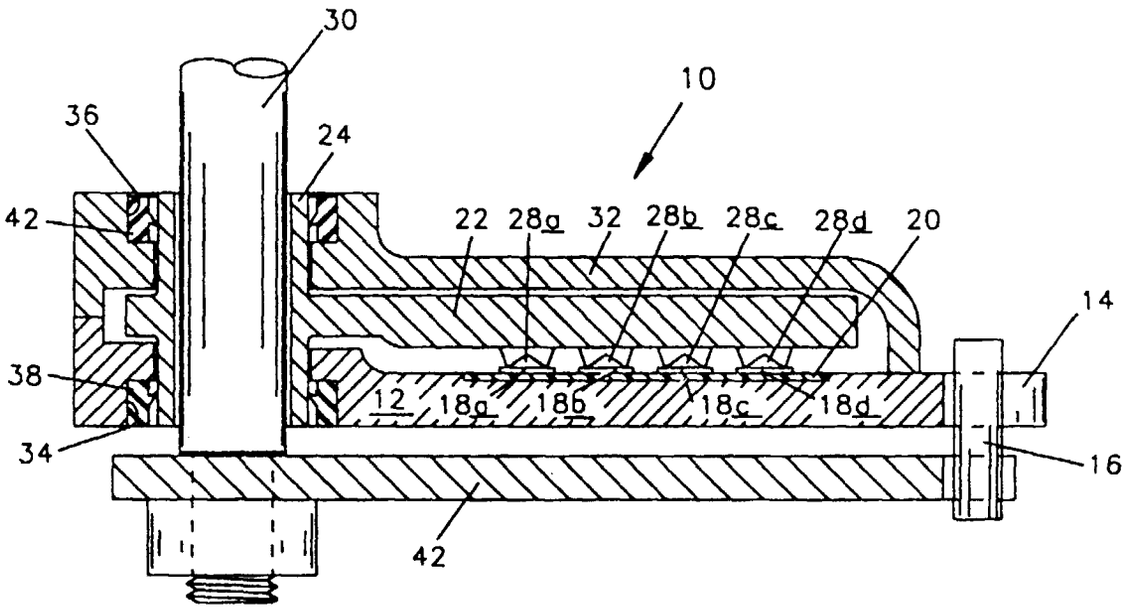
**1.** Dispositif d'interrupteur à utiliser avec un mécanisme de transmission de véhicule automobile ayant un arbre manuel monté de manière pivotante dans un alésage à travers une paroi d'un carter de protection de la transmission et ayant un axe longitudinal et un levier d'encliquetage avec une pluralité d'encliquetages sur une surface du bord externe de celui-ci, chaque encliquetage correspondant à une sélection d'engrenage de transmission spécifique, un galet se rapprochant et s'éloignant de l'arbre manuel et poussé en contact avec la surface du bord externe du levier d'encliquetage, le levier d'encliquetage étant monté sur l'arbre de sorte que l'orientation angulaire du levier d'encliquetage soit fixe par rapport à celle de l'arbre, le dispositif d'interrupteur comprenant un carter de protection d'interrupteur monté adjacent au levier d'encliquetage, le carter de protection d'interrupteur ayant deux extrémités opposées, une extrémité couplée au galet afin de maintenir ladite première extrémité du carter de protection dans une position fixe par rapport au carter de protection de la transmission, l'autre extrémité du carter de protection d'interrupteur étant montée de manière pivotante sur l'arbre manuel, le carter de protection d'interrupteur ayant une base, un bras d'interrupteur disposé à l'intérieur du carter de protection et monté de manière fixe sur l'arbre manuel de sorte que l'orientation angulaire du bras d'interrupteur par rapport à l'arbre manuel reste constante, au moins une partie du bras d'interrupteur disposé dans le carter de protection d'interrupteur étant d'une façon générale parallèle à et écartée de la base du carter de protection d'interrupteur, des moyens formant l'interrupteur montés à l'intérieur du carter de protection d'interrupteur comprenant au moins un premier contact électrique monté sur l'un d'entre le bras d'interrupteur et la base et au moins un deuxième contact électrique déplacé par ressort monté sur l'autre d'entre le bras d'interrupteur et la base, un des premier et deuxième contacts électriques étant adapté pour glisser entre des positions de mise en contact et de débrayage respectives avec l'autre contact électrique lorsque l'arbre manuel et le bras de l'interrupteur pivotent, et des moyens pour empêcher l'entrée de débris dans le carter de protection d'interrupteur, caractérisé en ce que le bras d'interrupteur et le carter de protection d'interrupteur présentent au moins une paire de parties de surface annulaires parallèles en vis-à-vis s'étendant autour de l'arbre manuel, chaque partie de surface annulaire se trouvant dans un plan perpendiculaire à l'axe longitudinal de l'arbre manuel et en ce que les moyens pour empêcher l'entrée de débris comprennent un élément d'étanchéité annulaire situé entre les paires de parties de surface annulaires parallèles en vis-à-vis et formé à partir de

matériau élastique et ayant des bords périphériques externe et interne se trouvant sur une desdites deux parties de surface annulaire avec une partie de surface courbe définie par rotation autour de l'axe de l'arbre d'un arc convexe partant d'un point du bord interne vers un point du bord externe, la partie de surface courbe ayant une valeur sélectionnée de hauteur de crête entre le plan de ladite première partie de surface annulaire et cette partie de la partie de surface courbe la plus éloignée de ce plan, les parties de surface annulaires parallèles étant espacées l'une de l'autre d'une distance inférieure à la valeur sélectionnée de la hauteur de crête des éléments d'étanchéité, de sorte qu'en cours de fonctionnement l'élément d'étanchéité soit comprimé entre les paires de parties de surface annulaires parallèles en vis-à-vis.

**2.** Dispositif d'interrupteur selon la revendication 1, dans lequel le carter de protection d'interrupteur et le bras d'interrupteur sont formés à partir de résine synthétique et l'élément d'étanchéité annulaire est formé à partir d'acier inoxydable.

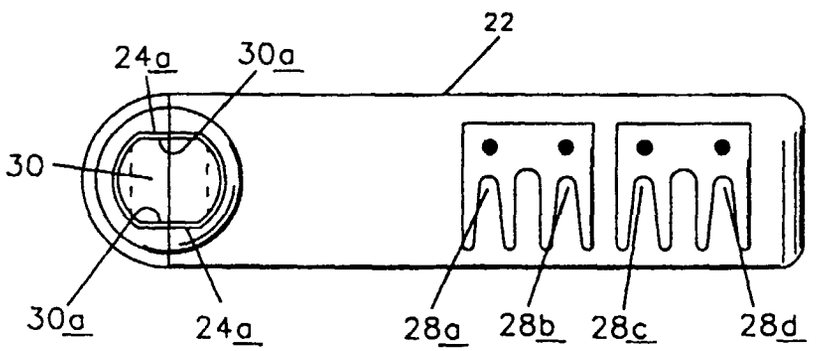
**3.** Dispositif d'interrupteur selon la revendication 1 ou la revendication 2, dans lequel le bras d'interrupteur et le carter de protection d'interrupteur présentent des secondes parties de surface annulaires alignées s'étendant autour de l'arbre manuel ayant des surfaces courbes adaptées partant dans une direction radiale.

**4.** Dispositif d'interrupteur selon la revendication 1 ou la revendication 2, dans lequel le bras d'interrupteur et le carter de protection d'interrupteur présentent deux secondes paires de parties de surface annulaires parallèles en vis-à-vis s'étendant autour de l'arbre manuel et un second élément d'étanchéité annulaire situé entre les deux secondes paires de parties de surface annulaires parallèles en vis-à-vis et élaboré à partir de matériau élastique et ayant des bords périphériques interne et externe se trouvant sur une des parties de surface annulaires parallèles de la seconde paire, avec une partie de surface courbe définie par la rotation autour de l'axe de l'arbre d'un arc convexe partant d'un point du bord interne vers un point du bord externe, la partie de surface courbe ayant une hauteur de crête sélectionnée entre le plan de l'une des parties de surface annulaire parallèles et cette partie de la surface courbe la plus éloignée de ce plan dans lequel se trouve les bords du second élément d'étanchéité, la seconde paire de parties de surface annulaires étant écartées l'une de l'autre d'une distance inférieure à la hauteur de crête sélectionnée.




PRIOR ART

FIG. 1.




PRIOR ART

FIG. 2.

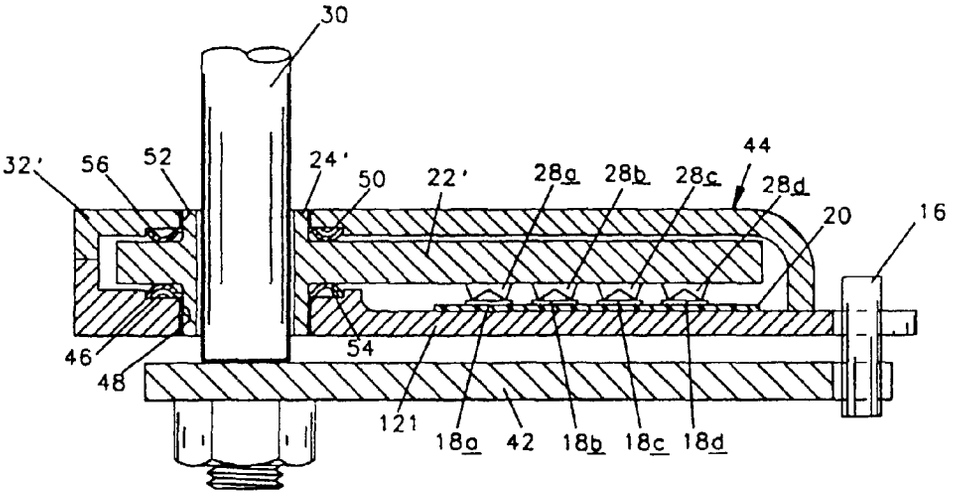



FIG. 3.

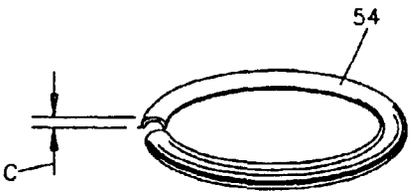



FIG. 3a.

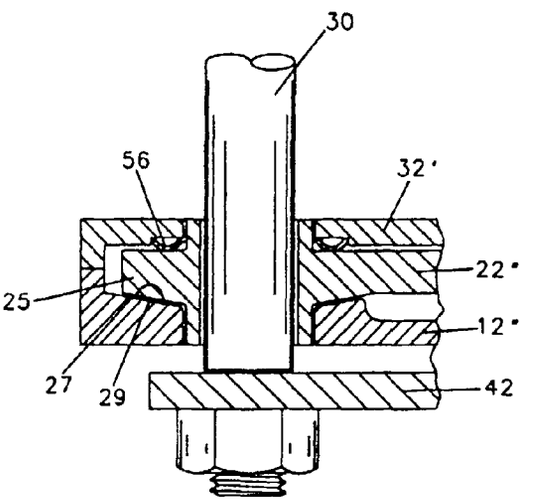



FIG. 4.